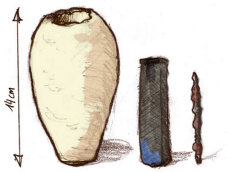
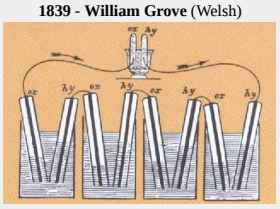
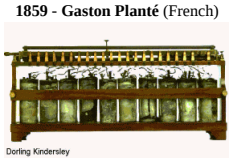
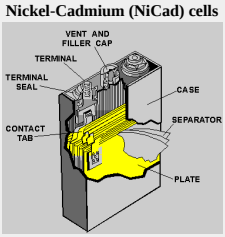
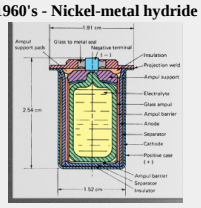
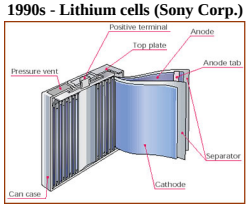
16.7: Timeline of Battery Development

Although the development practical batteries largely paralelled the expansion of electrical technology from about the mid-19th century on, it is now thought that a very primitive kind of battery was apparently in use more than 2000 years ago. The brief popularity of electrically powered automobiles in the 1920's encouraged storage battery development. The widespread use of portable "personal" electrical devices has kept the search for better batteries very much alive.

"Baghdad Battery" - 1000 BCE?  *Drawing of the three pieces. (CC-BY-SA 2.5; Ironie)*	Earthenware jars containing an iron rod surrounded by a copper cylinder were discovere believed to have been used by the Parthian civilization that occupied the region about 200(to plate gold onto silver.
Allesandro Volta 1782 	His "Voltaic pile", a stack of zinc and silver disks separated by a wet cloth containing a salt first battery known to Western civilization.
Sir Humphry Davy 1813	Davy builds a 2000-plate battery that occupies 889 square feet in the basement of Britain's I provided power for the first public demonstration of electric lighting (carbon arc).
Michael Faraday, 1830's	Faraday discovered the fundamentals of galvanic cells and electrolysis that put electrochem
1836 - Daniell cell (also known as a Crow's Foot or Gravity cell.) 	John Daniell (English chemist and meterologist) developed the **first modern storage cell** b consists of a large glass jar with a copper star-shaped electrode in the bottom and a zinc "cr suspended near the top. The bottom of the jar was filled with a concentrated copper sulfate dilute sulfuric acid, whose lower density kept it on top. This was the first practical battery t and railway signaling systems and home doorbells.
1839 - William Grove (Welsh) 	Grove was best known in the 19th century for his "nitric acid battery" which came into wid  Now, however, he is most famous for his "gas voltaic battery" in which discovered "revers H_2 and O_2 following electrolysis of water at platinum electrodes. This was the first demons hydrogen-oxygen **fuel cell** (see below.)
1859 - Gaston Planté (French)  	Invents the first **lead-acid storage cell** which consisted of two sheets of lead separated by a and immersed in dilute sulfuric acid.
1866 - Georges Leclanché (French) 	By 1868 twenty thousand Leclanché cells were being used in telegraph systems. The origin porous pots which were heavy and subject to breakage. Within twenty years other inventors we now know as "dry cells" which became widely used in the first flashlights (1909) and in 1920s.

1881 - Faure and others 	Development of the **first practical lead-acid storage cell**. The major improvement over Pl paste of $PbSO_4$ to the positive plate.
1905 Nickel-iron cell **(Thomas Edison)** 	Edison, who was as much a chemist as an all-around inventor, thought that the lead in Pla and that having acid in contact with any metal was an inherently bad idea. After muc successful alkaline battery. The **Edison cell** uses an iron anode, nickel oxide cathode, extremely rugged and is still used in certain industrial applications, but it was never able to had hoped.
1950s	A similar cell, employing a nickel anode instead of iron, was the first rechargeable cell that portable consumer devices. Its main disadvantage is that it is ruined by complete discharge.
1949 - Alkaline dry cell - Lew Urry (Eveready Battery Co.)	First commercial alkaline dry cell. These substitute KOH for the corrosive NH_4Cl used in th longer.
1947 - Mercury cell (Ruben and Mallory, 1950's)	This was one of the first "button"-type cells which were widely used in cameras and hearin output made them popular for use in sensitive instruments and cardiac pacemakers. The net $Zn(s) + HgO(s) \rightarrow ZnO(s) + Hg(l)$ Most countries have outlawed sales of these cells in order to reduce mercury contamination
Nickel-Cadmium (NiCad) cells 	The NiCad cell quickly become one of the most popular rechargeable batteries for small co high current and undergo hundreds of charge/discharge cycles. Because cadmium is an envi discouraged.
1959 - Fuel cell - Francis Bacon (UK)	The first practical fuel cell was developed by British engineer Francis Bacon (1904-1992). alkaline electrolyte and inexpensive nickel electrodes.
Late 1960's - Nickel-metal hydride cells 	The hydride ion H^- would be an ideal cathode material except for the fact that its oxidatio that certain compounds such as $LiNi_5$ and $ZrNi_2$ can act as "hydrogen sponges" made it pra cathode material. One peculiarity of Ni-MH cells is that recharging them is an exothermic heat must be allowed for. These batteries are widely used in cell phones, computers, and reactions take place in a concentrated KOH electrolyte: Cathode (+): $NiOOH + H_2O + e^- \rightarrow Ni(OH)_2 + OH^-$ Anode (-): $(1/x)\ MH_x + OH^- \rightarrow (1/x)\ M + H_2O + e^-$
1990s - Lithium cells (Sony Corp.) 	Lithium is an ideal anode material owing to its low density and high reduction potenti compact ways of storing electrical energy. Lithium cells are used in wristwatches, cardi Both primary (non-rechargeble) and rechargeable types have been available for some tir portable power tools and— perhaps most importantly, in electric-powered or hybrid automo Modern lithium cells operate by transporting Li^+ ions between electrodes into which the Cathodes are lithium transition-metal oxides such as $LiCoO_3$, while anodes are lithium-c that undergoes oxidation-reduction is not lithium, but the transition metal, e.g. Co(III)-Co(I

Lithium batteries as incendiary devices

There have been numerous reports of fires and explosions associated with lithium batteries. In 2006, the Dell Corporation had to recall 4.1 million Sony batteries that had been shipped with Dell's laptop computers and were judged to be at risk owing to a manufacturing defect. This illustrates the difficulty of concentrating a large amount of chemical energy into a small package, which is of course the goal of all battery developers eager to meet commercial demands ranging from consumer personal electronics to electrically-powered cars. The fully-charged Li^+-deficient lithium cobalt oxide cathodes are inherently unstable, held in check only by a thin insulating membrane which, if accidentally breached, can lead to thermal runaway involving gaseous oxygen, carbon, organic solvents, and (in some cases) lithium chlorate— all the components necessary for a fierce fire.

Much research has gone into the development of fail-safe membranes. In one type, made by ExxonMobil and targeted at the automotive market, the pores are designed to close up and thus inhibit the passage of lithium ions when the temperature rises above a safe level.

Biological Batteries

Finally, we should mention the biological batteries that are found in a number of **electric fish**. The "electric organs" of these fish are modified muscle cells known as *electrocytes* which are arranged in long stacks. A neural signal from the brain causes all the electrocytes in a stack to become polarized simultaneously, in effect creating a battery made of series-connected cells. Most electric fish produce only a small voltage which they use for navigation, much in the way that bats use sound for echo-location of prey. The famous electric eel, however, is able to produce a 600-volt jolt that it employs to stun nearby prey.